Chilopoda of Urban Greens in Warsaw

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ABSTRACT

A total of twelve Chilopoda species have been registered in three types of urban greens in Warsaw: seminatural wooded areas, big parks and streetside lawns. The common core of Chilopoda communities in all three types of urban greens contained six eurytopic species, with *Lithobius microps* as the most abundant. There were noticeable changes in the dominance structure of the epigeic part of Chilopoda communities related to urban greens types. *Lithobius microps* gradually replaced *Lithobius forficatus*, which is a very abundant species in wooded areas but relatively scarce in street lawns.

RÉSUMÉ

Chilopodes des espaces verts urbains de Varsovie.

Les peuplements de chilopodes ont été étudiés dans trois types d'espaces verts urbains à Varsovie : des boisements semi-naturels, de grands parcs et des pelouses situées près des chaussées. Le matériel a été récolté au cours de la période 1988-1990 à l'aide d'échantillons de sol et de pièges Barber. Au total, on a récolté douze espèces de chilopodes dont le plus grand nombre se trouve, en moyenne, dans les boisements (5,8), alors que la plus faible richesse spécifique est enregistrée dans les pelouses (4,5). Dans les trois types d'espaces verts, les six espèces communes apparaissent avec une constance dépassant 50% et constituent environ 2/3 de la composition taxonomique du peuplement. Ce sont : *Lithobius microps*, *Necrophloeophagus flavus*, *Schendyla nemorensis*, *Geophilus electricus*, *Strigamia crassipes* et *Lithobius forficatus*. Dans les trois types d'espaces verts *L. microps* prédomine. L'analyse des structures dominantes des peuplements de chilopodes à l'aide des indices de Morisita, de l'homogénéité de domination et de rangs, a montré l'existence de changements dépendant du degré d'anthropogénisation des espaces verts urbains. Dans le compartiment épigéique, on a observé que l'importance relative de *L. microps* s'accroît au détriment de *L. forficatus*, qu'il remplace progressivement.

INTRODUCTION

Studies of Chilopoda conducted over the last several decades in many European cities, e.g. in Copenhagen (ENGHOFF, 1973), Kiel (TISCHLER, 1980), Göteborg (ANDERSSON, 1983) and Rome (ZAPPAROLLI, 1992) indicate that urban Chilopoda communities are characterized by high proportions of alien species and a significant degree of faunal diversification. Striking differences in the abundance of Chilopoda are noted between individual study sites. Equally unusual is the occurrence of many species as single specimens, a phenomenon which was particularly conspicuous in a quantitative study carried out in Bonn Bad-Godesberg (FRÜND, 1989; SCHULTE *et al.* 1989). We do not know yet, however, whether Chilopoda communities inhabiting different types of urban greens belong to one or more faunal associations, in other

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words, whether the differences in species composition and species abundance are accidental or testify to their individual characters. The following paper analysing Chilopoda of urban greens of Warsaw attempts to provide an answer.

MATERIAL AND METHODS

Sampling areas

The research was carried out in 13 sampling areas that represented 3 types of urban greens (Fig. 1):

1. *wooded areas* with ground cover growing spontaneously. Such areas are not subject to regular horticultural practices (e.g. digging over or raking). They are located along the edge of the erosion valley of the Vistula river that cuts across the area of Warsaw. Areas W1 and W5, situated on the outskirts of Warsaw, represent the linden-oak-hornbeam forest in phytosociological terms. Areas W1-W4 are characterized by a high inclination angle. Area W5 is the only one situated on the upper erosion terrace within the *Lasek Bielañski* reserve.

2. *park lawns* are subject to regular horticultural practices i.e. lawn trimming and litter raking. Areas P1-P4 are located within larger park areas at least 50 meters away from a roadway.

3. *street lawns* (S1-S4) are situated in the immediate vicinity of busy arterial roads.

Sampling methods

Two sampling methods were used for collecting Chilopoda:

1) BARBER's pitfall traps. 10 traps were placed in each area. The animals were collected once a fortnight from April 1988 to March 1990;

2) soil samples with an area of 0.1 m2, taken down to a depth of about 25 cm. 3 or 5 samples were taken in May and September 1990. 32 soil samples were taken altogether in each of the three types of urban greens. The specimens were sorted by hand.

FIG. 1. — Location of the urban greens in Warsaw.

RESULTS

Species composition

12 species of centipedes were recorded from urban greens in Warsaw (Table 1). The greatest numbers of species were found in wooded areas - 5.8 on average, compared to 5.0 in park lawns and only 4.5 in street lawns. As far as the number of species is concerned, the Chilopoda communities of urban greens of Warsaw are not basically different from forest Chilopoda communities of Central Europe, where 5-10 species are usually recorded (THIELE, 1956; ALBERT, 1979; BECKER, 1982; FRÜND, 1987; KACZMAREK, 1989; WYTWER, 1990, 1992).

TABLE 1. — Species of Chilopoda in urban greens of Warsaw.

N°	Species	wooded areas					parks				street lawns			
		W1	W2	W3	W4	W5	P1	P2	P3	P4	S1	S2	S3	S4
1	*Lithobius forficatus* (L.)	+	+	+	+		+	+			+			
2	*Lithobius melanops* Newport								+					
3	*Lithobius mutabilis* L. Koch	+				+								
4	*Lithobius crassipes* L. Koch				+									
5	*Lithobius microps* Meinert	+	+	+	+	+	+	+	+	+	+	+	+	+
6	*Lamyctes fulvicornis* Meinert								+					
7	*Necrophloeophagus flavus* (De Geer)	+	+	+	+	+	+	+	+	+	+	+		+
8	*Clinopodes linearis* (C. Koch)							+						
9	*Geophilus electricus* (L.)	+	+	+	+		+		+	+	+	+		+
10	*Brachygeophilus truncorum* (Berg. & Mein.)													+
11	*Strigamia crassipes* (C. Koch)	+	+	+	+	+	+				+	+		
12	*Schendyla nemorensis* (C.Koch)	+		+		+	+	+		+	+	+	+	+
	Number of species	7	5	6	6	5	6	5	5	4	6	5	2	5

The following six species occurred in all the three types of urban greens and were consequently considered to be common: *Lithobius forficatus, Lithobius microps, Necrophloeophagus flavus, Geophilus electricus, Strigamia crassipes* and *Schendyla nemorensis*. The similarity of the species composition of such communities, expressed as the MARCZEWSKI-STEINHAUS index (MARCZEWSKI & STEINHAUS, 1958) oscillates closely around 60% (Table 2).

TABLE 2. — Similarity (in percent) of species composition in Chilopoda communities in urban greens of Warsaw according to MARCZEWSKI-STEINHAUS index (MS).

Type of urban greens	MS
wooded areas x parks	54.5
parks x street lawns	60.0
wooded areas x street lawns	66.7

In order to determine the degree of fidelity of individual Chilopoda species to the urban green habitat, a constancy analysis was performed using TISCHLER's method (TISCHLER, 1949). The analysis revealed the presence of two groups of species (Fig. 2). The first group is characterized by an index of constancy above 0.5 and is composed of the same six species listed above as common to communities of all the three types of urban greens. The other group consists of species with much lower values of constancy (below 0.2).

It can be assumed that the Chilopoda species occurring in all the three types of urban greens and characterized by high constancy indices form the core of the Chilopoda communities

of urban greens. The species from the other group are found occasionally in single sites and function as accessory elements of the community.

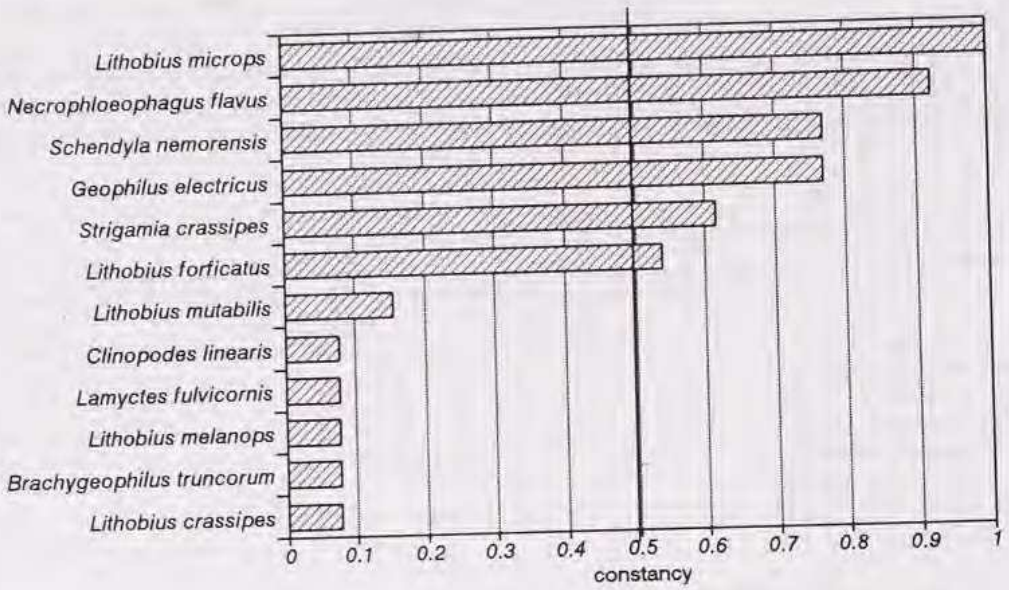

FIG. 2. — Constancy of occurence of individual Chilopoda species in the urban greens of Warsaw.

The structure of dominance

The combining of the two methods of sampling helped to clarify and compare the dominance structure of Chilopoda communities inhabiting the surface and the deeper layer of soil (Fig. 3a, b). The similarity of dominance relationships are well reflected by MORISITA's index - MO (HORN, 1966) and the index of homogeneity - HD (RIEDL, 1963). When the centipede fauna of the deeper layers of soil is analysed, the values of both indices are relatively high - above 90 and 70% (Table 3). Therefore it can be assumed that the structure of this part of the community is uniform in all types of urban greens in Warsaw.

TABLE 3. — Similarity (in percent) of dominance structure of Chilopoda communities. MO: index of similarity (MORISITA index); HD: index of homogeneity, based on the species dominance structure; HR: index of homogeneity, based on the ranks of dominance structure.

Method	Type of urban greens	MO	HD	HR
soil	wooded areas x parks	98.5	80.2	83.1
samples	parks x street lawns	96.0	73.8	74.0
	wooded areas x street lawns	98.1	78.2	78.1
pitfall	wooded areas x parks	79.4	51.0	83.9
traps	parks x street lawns	75.2	42.0	41.2
	wooded areas x street lawns	55.3	32.0	36.9

The similarity of the dominance structures of the epigean parts of Chilopoda communities of different types of greens is expressed by much lower values of the both indices - below 79 and 51%. This is mostly caused by a decrease in the proportion of *Lithobius forficatus* in parks and street lawns (Fig. 3b). This species is being gradually replaced by *Lithobius microps*.

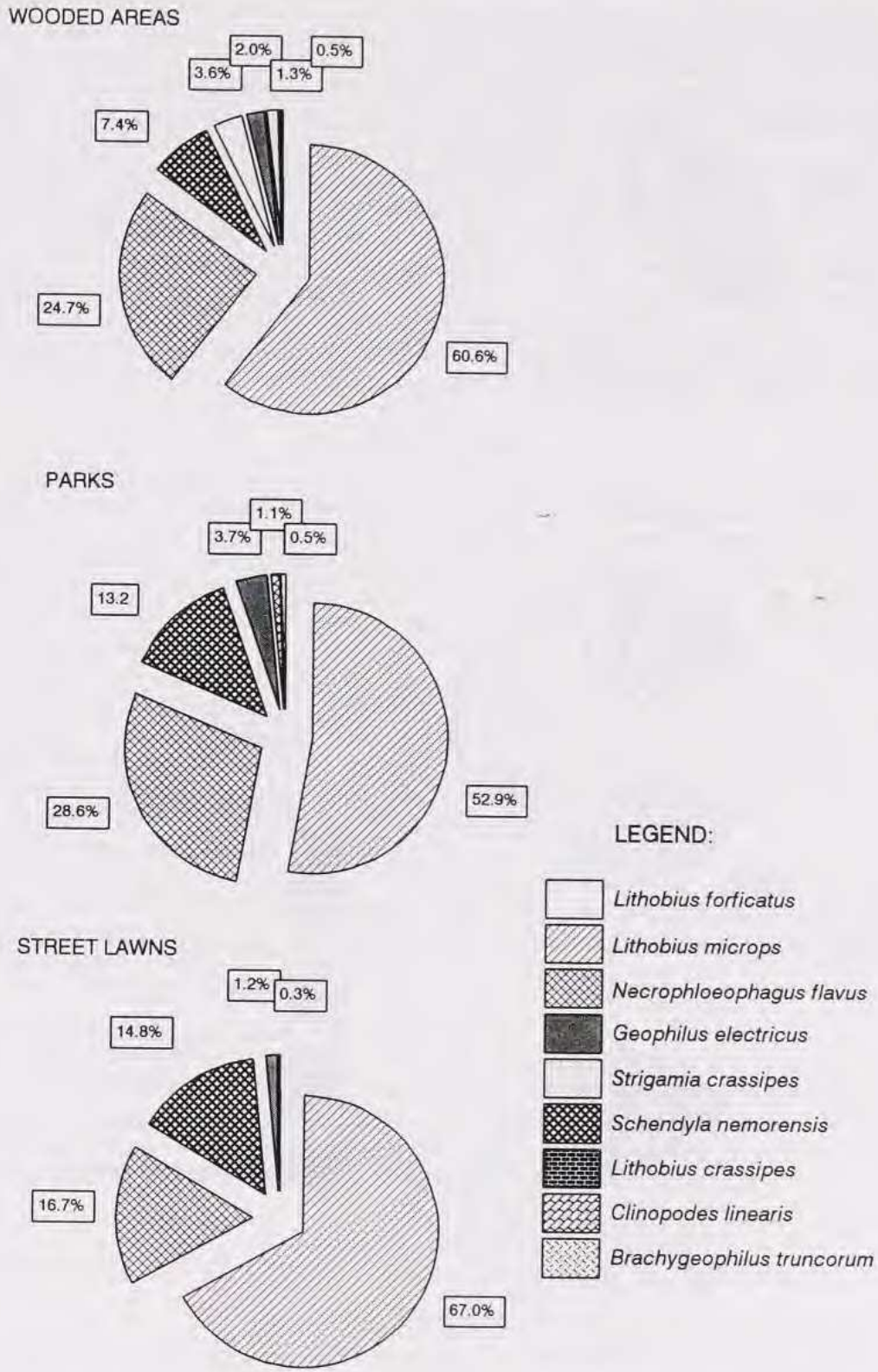

FIG. 3a. — Percentage contribution of Chilopoda species in the soil sample material.

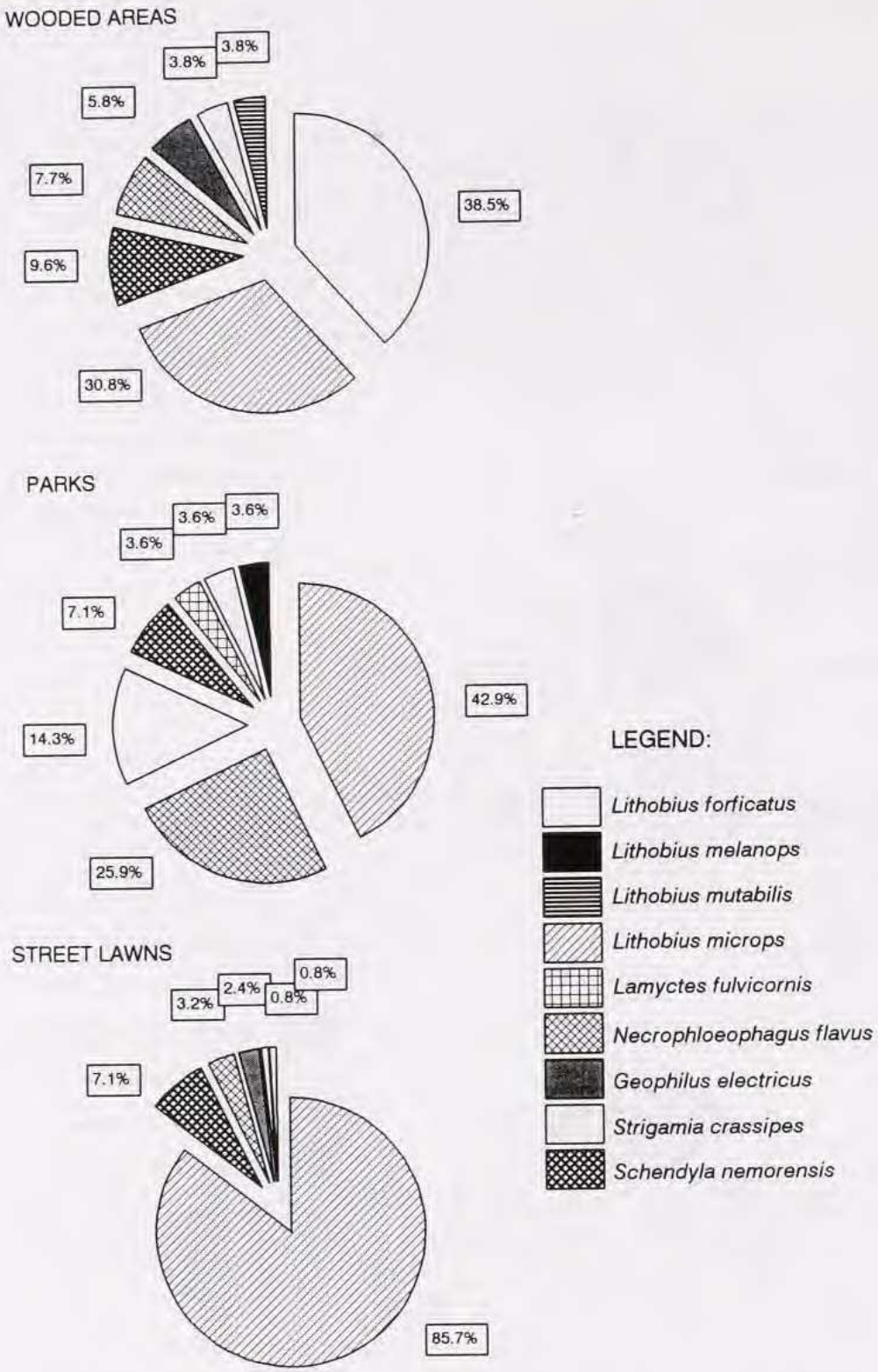

FIG. 3b. — Percentage contribution of Chilopoda species in the pitfall trap material.

The structure of dominance of the epigean component of Chilopoda communities is undergoing major changes. This is not, however, a sign of a change of the dominance model of Chilopoda communities in various types of urban greens. The degree of overlap of the dominance models has been determined by means of a homogeneity coefficient, where dominance models arranged according to the ranks (shares) of species provided a basis for the analysis. Owing to this similarity of dominance relations could be analysed irrespective of the fact what species takes succeeding position. The values of "ranks homogeneity coefficient" (HR) indicate that the communities of wooded areas and parks have a very similar dominance model (Table 3). It differs, however, from the dominance model of Chilopoda communities of the street lawns, particularly in the epigean layer, where the dominance of *Lithobius microps* is very strong. Therefore, the restructuring of Chilopoda communities under marked urbanizing pressure, which is currently taking place in urban greens, affects above all else the epigean forms. Species inhabiting deeper layers of soil are able to preserve structural relations in an almost intact form, the only modifications being due to the exchange of accidental species.

DISCUSSION

Except for *Strigamia crassipes*, all the species which form the core of Chilopoda communities of urban greens are known to be eurytopic and occur in most of the European cities where centipede fauna has been studied. The occurrence of *S. crassipes* in urbanized environments could have been underestimated so far since this species reaches its maximum of abundance in winter (BARBER & KEAY, 1988) and is therefore not included in faunal studies of Chilopoda. Most individuals of this species were collected by pitfall trapping in early spring (end of winter) and late autumn.

The accidental species which have been found in parks and street lawns are known to spread by means of horticultural practices in artificial man-made environments as it is the case with *Clinopodes linearis* and *Brachygeophilus truncorum*. On an other hand, wooded areas and old parks in the centre of the town are often abundant in species that once inhabited the natural habitats, such as *Lithobius crassipes, Lithobius melanops* and *Lamyctes fulvicornis* which are able to remain in a synanthropic environment. However, they are not able to occur on the street lawns because they belong to the epigean part of the community which is undergoing marked structural transformations. An exclusively forest species, such as *Lithobius mutabilis*, has survived only in wooded areas on the outskirts of the city (linden-oak-hornbeam forest) as it is a constant and important element in Chilopoda communities of this habitat type in the Mazovian Lowland (WYTWER, 1990).

CONCLUSION

One type of centipede community can be considered to occur in urban greens of Warsaw, its core consists of 6 eurytopic species that do not avoid "synanthropised" environments. The other species are distributed randomly among various sites where they function as accessory species. The influence of the urban environment on the structure of Chilopoda communities manifests itself in marked transformation of the epigean part of the community.

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